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OBSERVATIONS

ON THE

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ENEMIES OF THE COFFEE TREE IN CEYLON.

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Cc.

By J. NIETNER, Esq.

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OBSERVATIONS ON THE NATURAL HISTORY OF THE ENEMIES OF THE COFFEE TREE IN CEYLON.

In publishing these observations (which may be looked upon as a continuation of a general notice of noxious Ceylon insects, published by me in Stettiner Ent. Zeitung, 1857,) I have a twofold object in view: first, the diffusion of a *correct* knowledge of the subject which they embrace amongst my brother Planters, and secondly to furnish a contribution to biographical and economic entomology—a branch of the science which is now being daily more and more appreciated. In judging of apparently trivial passages as well as of scientific technicalities, which occur in the text, this must be borne in mind. To those of my brother Planters who would have wished for more elementary explanations than space permitted me to introduce, I can strongly recommend "Westwood's Introduction to the Modern Classification of Insects," 2 vols., with numerous woodcuts, as a most excellent and inexhaustive source of information

The numerical list given below might easily be doubled by minute research in the outlying districts, and introduction of unimportant species. However, such as it is, it holds good for the entire Coffee region of Ceylon in general, and for the cluster of districts grouped round the Peacock-hill (my special field of research) in particular. In fact, the brown and white bug, and the black and white grub, are the only universal and important enemies of the Coffee-tree. The destructions of Arhines, Limacodes, Zeuzera, Phymatea, Strachia and the Coffee-rat, appear to be of a more local and occasional nature, and are therefore of less importance. The rest of the species are nearly all enumerated for the sake of scientific completeness only. To the gentlemen, both here and in Europe, who have assisted me, I beg to tender my best thanks.

A few statistical notes will not be uninteresting to the reader abroad. The hill region of Ceylon covers an area of about 2,000 square miles, is of a somewhat circular form, and its most elevated peaks rise to 8,280 feet above the level of the sea. Systematic Coffee planting is, from physiological reasons, exclusively carried on in these hills, although irregular native garden-plantations are found everywhere in the Island, even close to the sea-beach. The favorite elevation is between 1,500 and 3,500 feet, but in a few exceptional cases Estates descend almost to the foot of the hills, whilst others are situated as high as 5,500 feet and more. The number of systematically worked Coffee Estates, scattered all about these hills, amounts to about 420, divided amongst 28 districts (very widely differing in some instances in phyiscal aspect), covering an area of about 90,000 acres, producing about 600,000 Cwts. of clean Coffee (worth on the spot about 1½ million Pounds Sterling), and giving employment to upwards of 100,000, persons chiefly Tamil labourers from the coast of India. This is exclusive of about 50,000 acres of Native Coffee. It seems that the Coffee-tree was brought to Ceylon by the Dutch, about 200 years ago, but the first Estate was only opened in 1825.

I now give a list of the names of the enemies of the Coffee-tree and their parasites (in which I have not thought it necessary to adhere strictly to systematic order), and then proceed to detailed descriptions.

LIST OF THE ENEMIES OF THE COFFEE TREE AND THEIR PARASITES.

HEMIPTERA.

1. *Pseudococcus Adonidum* L? (White or mealy bug.)
   Parasites: Scymnus rotundatus. Motch. Et. ent. 1859.
   Encyrtus Nietneri Motch. lot. cit.
   Chartocerus musciformis. Motch lot. cit.
   Acarus translucens. N.
2. *Lecanium Coffeæ*, Walk. List Ins. B. M. (Brown or scaly bug.)
   Parasites: Scutellista cyanea. Motch. loc. cit.

Cephaleta purpureiventris. Motch. loc. cit.
„ brunneiventris. Motch. loc. cit.
„ fusciventris. Motch. in litt.
Encyrtus paradisicus. Motch. in litt.
„ Nietneri. Motch.
Cirrhospilus coccivorus. Motch. in litt.
Marietta leopardina. N. in litt.
Chilocorus circumdatus. Schonh.
Acarus translucens. N.

3. *Lecanium nigrum.* N. (Black bug.)

4. { *Syncladium Nietneri.* Rabh. Dresd. Hedwig. 1858.
   Triposporium Gardneri. Berk. J. Hort. Soc. Lond. 1849.
   A fungus.

5. *Aphis Coffeæ.* N. (Coffee-louse.)
   Parasites: Syrphus Nietneri. Schiner in litt.
   „ splendens. Dolesch.
   Micromus australis. Hag. Verz. Wien. z.-b. G. 1858.

6. *Strachia geometrica.* Motch. in litt.

LEPIDOPTERA.

7. *Aloa lactinea.* Cram pap. ex.
8. *Orgyia Ceylanica* N.
9. *Euproctis virguncula.* Walk. loc. cit.
10. *Trichia exigua.* Feld. in litt.
11. *Narosa conspersa.* Walk. loc. cit.
12. *Limacodes graciosa.* Westw. Ent. cab.
13. *Drepana?*
14. *Zeuzera Coffeæ.* N.
15. *Agrotis segetum.* Wien. V. (Black grub.)
16. *Galleriomorpha lichenoides.* Feld. in litt.
17. *Boarmia Ceylanicaria.* Feld. in litt.
18. „ *leucostigmaria.* Feld. in litt.
19. *Eupithecia Coffearia.* Feld. in litt.
20. *Tortrix Coffearia.* Feld. in litt.
21. *Gracilaria? Coffeifoliella.* Motch. loc. cit.

DIPTERA.

22. *Anthomyza? Coffeæ.* N. in Motch. loc. cit.

ORTHOPTERA.

23. *Phymatea punctata.* D.

COLEOPTERA.

24. *Ancylonycha spec?* (White grub.)

25. *Arhines? destructor.* N.

APTERA.

26. *Acarus Coffeæ.* N.

MAMMALIA.

27. *Golunda Ellioti.* Gray in Kel. Prod. (Coffee-rat.) *

DESCRIPTIONS AND OBSERVATIONS.

1. *Pseudococcus Adonidum,* (White or mealy bug.) *Male*: Head rather square, enlarged behind and rounded off at the posterior angles; eyes prominent, black; ocelli 2, small, lateral; antennæ 9 jointed, 2nd joint longest, 3rd shortest, 4-9 subequal; mouth externally represented by 2 black knobs resembling blunted mandibles. Thorax ample, oblong—quadrate, enlarged at the shoulders; wings 2, ample, 2-nerved, hyaline, strongly iridescent, laid straight down the back, half overlapping each other when at rest. Scutellum ample, transverse, rounded at the apex. Abdomen subcylindrical, of shrivelled appearance, with 2 long anal setæ, which are slightly curled, and of mealy, brittle, consistence. The insect is of light dirty-brownish color and slightly hairy; it is very minute, (very much smaller than the females; only about $\frac{1}{8}$ line long), and resembles certain small Ephemeridæ or May-flies.

Female: Apterous, oval, brownish—purple, covered with a white mealy powder which forms a stiff fringe at the margin (one tooth or tuft to each segment on either side), and at the extremity of the abdomen 2 setæ. The back is laid out in 3 longitudinal and a number of transverse corrugations, the latter corresponding with the number of segments, upon each of the 3 longitudinal corrugations the mealy secretion forms a sort of ridge-cap. The feelers, legs and promuscis, are of light-brown color and slightly hairy. The former are setaceous, 8-jointed (the last joint being the longest),

* The species marked Motch. in litt. and N. in litt. will probably be found described in Motch. Et. Ent. 1860.; those marked Feld in litt. and Schiner in litt. probably in Wien. Ent. Monatsch. 1860.

nearly as long as the legs and porrected. The promuscis is situated between the anterior pair of legs, having a few hairs, but no sucking bristles at the tip.

The larvæ and pupæ of the female resemble the perfect insect, but are on a smaller and less perfect scale. In the male pupa wings and anal setæ are rudimental, in the male, larvæ absent. These imperfect males rather resemble young Psoci or Aphides, but they carry the antennæ turned backwards, along the sides of the body. The larvæ and pupæ are active—move about.

The insects, in all stages of development, are found all the year round, the propagation being continuous. It appears to me, however, that the males are more plentiful about June and January, than at any other season. They affect dry, hot localities, and are found as well on the branches as on the roots of the trees, to about 1 foot under ground. The eggs are actually laid and enveloped in a white cottony substance; they are oval and of yellow color. I am not sure that there are not two species in the Island, as I find some communities rather flatter and more densely covered with meal. However, these may be local varieties. The white bug of the Ceylon Coffee-tree seems to be identical with the species which is naturalized in the conservatories of Europe, and is perhaps a cosmopolite. It is closely allied to the *Pseudoc. Cacti* of Linnæus, the Cochineal insect. There are several insects in the Island resembling the white bug, but being of the size of a six-penny, and even shilling-piece, these belong to the g. *Dorthesia,* and I have generally found the up-country species upon the stem of a Laurel—*Tetranthera Gardneri Thw.*

For general observations on the bug, see further on, after the description of the brown and black bug.

The white bug is preyed upon by the larva of

Scymnus rotundatus.

This is a minute beetle of the lady-bird tribe, as big as a pin's head, black and pubescent. The larva greatly resembles the white bug, and might easily be mistaken for it. It is, however, longer, narrower, flatter, and of a yellow color, but

covered thickly with stiff white hair of the same cottony substance as those of the bug. This covering is occasionally renewed, and is especially thick when the metamorphosis is at hand. This latter the larva undergoes in a thin oval cocoon, to which the white covering of the larva remains externally attached. This larva is very active and attaches itself to the underside of the bug. I have reared several in March and April, 1859, in empty bottles. Westwood, Introd. Vol. I., 398, mentions the larva of a Scymnus feeding upon Aphides, and Vol. II. 443, feeding upon Aleurodes. The larva of the Scymnus is an external parasite, and M. de Motchulsky is wrong in stating that I had discovered it "*dans* le Pseudoc."

The white bug is also preyed upon by the larvæ of

Encyrtus Nietneri and

Chartocerus musciformis,

two minute Hymenoptera (wasps,) the former of yellowish color, and common, the latter black and scarcer. They are only $\frac{1}{8}$ "" long. There is also a very minute whitish-translucent mite which is found mixed up with the bug, and no doubt injures it to some extent. I will call it

Acarus translucens.

2. *Lecanium Coffeæ.* (Brown or scaly bug.) *Male:* Head transversely ovate-rotundate, narrowed, and square in front; eyes large, black; ocelli 2, small, lateral; antennæ 9-jointed, 2nd joint smallest, 3rd longest, thence decreasing to the tip; mouth as in the male of the white bug. Thorax ample, cordiform, narrowed in front; wings 2, hyaline, 2-nerved, subcostal nerve dark pink, not folded straight down the back when at rest, but half spread out. Scutellum as in white bug. Abdomen triangular—subcylindrical, of shrivelled appearance, with 2 lateral points, 1 central appendage, and 2 long, thin, white filaments at the extremity. The insect is still more delicate than the male Pseudococcus, of clear, light pinkish-brown color, slightly hairy; very pretty.

Female: apterous, tortoise-like, yellowish, marbled with grey or light brown, sub-oval, more or less semi-globose according to age, back with 1 elevated longitudinal, and 2 transverse costæ, uneven;

split behind, at the extremity of a split bifid anal flab of brown color; eyes marginal, black; antennæ 7-jointed, 3rd joint longest; promuscis with 1 long sucking bristle. The old individuals are light brown with a dark margin, smooth, semi-globose, fixed to the branch.

Larvæ of Female with 2 anal filaments which are lost in after-life. The larvæ and pupæ of both sexes are active, with the exception of the male pupa, which is plentiful on the underside of the leaves where the long, narrow, oval shell under which it rests is easily discovered. This shell is transparent, and composed of 9 plates, 3 central and 3 on either side. I have occasionally found the entire underside of leaves covered with nothing but male pupæ, all dead. This species of bug affects elevated (above 3000 feet), cold, damp, close localities, where it is found in all stages of development all the year round, the propagation being, as in the white bug, continuous. As in the latter species, the males seem to be more abundant about June and January, than at any other season. The eggs, which are oval and of pinkish color, are not actually brought forth by the female, but when they are matured the parent insect dies, her whole interior forming one mass of eggs protected by the shell.

This kind of bug is closely allied to the lac-insect (*Coccus Lacca.K.*) of India.

The brown bug is much infested by parasites, amongst which the following are the most common:

Scutellista cyanea,
Encyrtus Nietneri,
„ *paradisicus,*
Cephaleta purpureiventris.
„ *brunneiventris,*
„ *fusciventris,*
Cirrhospilus coccivorus,
Marietta leopardina.

These are all Hymenoptera of the most minute description, presenting under the microscope the most elegant forms, and for the most part the most brilliant metallic colors. The Marietta, for instance, is spotted or ocellated all over black and white, like a leopard. They can easily be obtained by putting a bugged branch,

cut inconvenient lengths, into a bottle, when after some time the little wasps will be found flying about inside, having made their escape from the bugs. The mother parasite lays her eggs amongst the bugs; when hatched, the young larvæ find their way easily to the soft underside of the bugs, where they attach themselves like leeches, and, protected and fed by the body of the bug, remain until they reach the perfect state. A bug thus attacked produces of course no eggs, and instead of the young bugs, in course of time there escape these little wasps. The shells of the old bugs are frequently found with one or two holes—it is from these that the parasites have escaped. I have seen as many as 6 larvæ (belonging to different species of Hymenoptera) attached to one single bug. These larvæ can easily be seen on turning up some old bugs with the point of a pen-knife; they are little white or yellowish, eyeless and footless maggots, some of which can leap to a considerable distance by doubling themselves up and spasmodically extending themselves again to their full length.

I shall revert to this subject again, further on.

On examining old full-grown bugs, the shells are often found filled, not with eggs, but with a white flaky substance, amongst which the above-mentio ned mite,

Acarus translucens,

is seen busy. I have thought that the mite might have been the destroyer of the eggs in these cases, and that the flaky substance were the empty and decomposing egg-shells, but feel not certain on this subject. The Planter has another friend in the larva of a kind of lady-bird which feeds upon the bug, viz., that of the

Chilocorus circumdatus

(Syn. Ch. nigro-marginatus. N. in Motch. Et.) This larva is of ashy-grey color, furnished with black spots and rows of black spines. The perfect insect rather resembles a full grown bug, being semi-globose, light brown, with black margin round the elytra. There is a variety which is altogether dark-brown. The larva skin splits, but is not thrown off when the insect assumes the pupa state. When the imago, or perfect insect, issues from its double shell, it is white, turns round (head towards tail of skins),

and sits in this position upon its former envelopes for 24 hours before it moves off. During this time it gains its proper coloring. It is common at all seasons, but especially from March to September, and in all stages of the metamorphosis, the larva generally fixing itself to the underside of the leaf when its transformation approaches.

3. *Lecanium nigrum.* (Black bug.)

The male of this species is unknown to me. The *female* is shield-like, much larger and flatter than the brown bug, color from yellowish grey to deep brown and almost black, according to age; sub-oval, back with 1 longitudinal and 2 concentric oval costæ on disc, towards the margin slightly corrugated. The shell, seen through a microscope, is found to be composed of minute compartments, like the pavement of a street. Anal slit, and flab as in female brown bug. Old female shield-like, black, with slight longitudinal costa.

Larva. with 2 long, black anal setæ and projectile tube.

This specis occurs alone and intermixed with the brown bug, but it is very distinct and at once recognised. It is much less abundant and therefore, of no importance to the Planter. I have not succeeded in raising parasites from it.

In the natural course of my observations, I must now mention a fungus, viz:

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4 { Syncladium *Nietneri*,
  { Triposporium *Gardneri*.

As soon as the bug has fairly established itself upon a Coffee tree, this latter begins to be covered with a fine black tissue which upon examination proves to be a fungus of the above-name. It comes and goes after the bug—never alone: first it has the appearance of a thin, diluted blackwash, but, rapidly increasing in density, within two or three months it quite covers and blackens the leaves and other parts of the tree, finally almost resembling moss. It's period of growth seems to extend over about twelve months, when it is replaced by a young growth

or leaves the tree with the bug. When leaving the tree it peels off in large flakes. As the occupation of a Coffee, or any other tree, gives rise to the appearance of a glutinous, saccharine substance—Honey-dew—(either a secretion of the bug or the extravasated sap which flows from the wounded tree, but more probably a combination of both,) which disappears with the bug, and as the fungus does exactly the same, I have no doubt that its vegétation depends upon the Honey-dew. There appears to be some doubt whether there are one or two species of this fungus upon the Coffee tree: The late Dr. Gardener sent a specimen to the Rev Mr. Berkeley, the eminent English cryptogamist, who described it as Trip. Gardneri. I sent two years ago, specimens both to Mr Berkeley and Dr. Rabenhorst of Dresden, when the latter named it Syncl. Nietneri informing me upon enquiry, that it was quite different from the Triposporium having *simple sporæ* whilst those of the latter are *composite.* Mr. Berkeley said that he was not certain whether the specimen I sent him was in a different state or a different genus from his Triposporium. Remembering the extraordinary changes plants of such simple organism as the one under consideration, undergo in the course of their development, I should feel inclined to think that Syncladium and Triposporium are one and the same, but am unable to finally decide on this point which, moreover, is of little consequence. Of more interest is it that Dr. Rabenhorst received the identical fungus at the same time from me and from a correspondent in Nizza (Nice) where it covers the leaves of the Olive-tree in the same manner as it does the Coffee tree here. It would be curious to know whether its development there, depends upon honey-dew as, to all appearances, it does here.

I now add some general observations on the Coffee bug :

Most Planters with whom I have conversed on the subject, not being entomologists, appeared to look upon the Coffee bug as something most unaccountable, almost mysterious, entertaining very erroneous and extraordinary ideas regarding it. The fact is that there is nothing whatever unusual or extraordinary about it, excepting the apparent capriciousness with which it comes and goes :

now rapidly spreading over a whole Estate, now confining itself to a single tree amongst thousands; here leaving an Estate in the course of a twelvemonth, there remaining for ever, and so forth. The members of this family of insects (Coccidæ,) to say nothing of the entire order (Homoptera,) are in many instances of very great economical importance. I have already mentioned the Cochineal and Lac-insects as amongst the most prominent in this respect, but whilst these are useful, there are, on the other hand, others which are an excessive nuisance to the gardener and agriculturist. Foremost amongst these ranks undoubtedly, the Coffee bug; and the *blight* of the Sugar-cane in the Mauritius, also belongs to this family (Aspidiotus?). In an entomological point of view, these insects are interesting from other reasons. The habits of the Coccidæ have, consequently, long since been the object of study with entomologists. Westwood (Introd. 1840) in his bibliographical reference of the Coccidæ, mentions not less than between 30 and 40 authors who have written on this subject. In fact every general entomologist from Linnæus downwards, has noticed them. The study was facilitated by the circumstance that there are many species indigenous to Europe.

Although, as above-stated, the Coffee tree has been known in Ceylon for about 200 years, and although systematically worked Estates have existed since 1825—the bug does not appear to have attracted attention, that is to say, not to have appeared in large quantities, till about 1845, when, however, it began to spread with such rapidity that in 1847 a very general alarm was taken by the Planters. It will be remembered that about the same time the Potatoe, Vine, and Olive disease began to become very alarming in Europe. With reference to this comparatively recent appearance of the bug in the Island, it has been suggested, that it was not indigenous, but had been introduced with seed-Coffee, from some other country. However, the grounds for this assertion are insufficient, and I consider it as indigenous, seeing that it is found upon many other plants besides Coffee: I have seen the white bug upon Orange, Guava and other trees, also upon vegetables, Beetroots &c. The brown bug is still less particular, and attacks almost

every plant and tree that grows on a Coffee Estate, more particularly though, such as are grown in gardens: Guavas, Hibiscus Ixoras, Justicias, Oranges—everything, even weeds. It has also been said that the brown bug came originally from the wild Guava (Psidium pyriferum) upon the Coffee, but this seems to me improbable, because I have never seen the Guava bugged in its *wild* state, and I have had very good opportunity for observation. It is, however, not to be denied that the bug gives it a decided preference when it grows with other trees on a Coffee Estate. I have already alluded to the *capriciousness* of the bug: why, as is its wont, instead of spreading itself evenly over on Estate, as one would expect it to do, it should attack a certain field only, then after a while leave that and go to another, and then to another, and another, it would not be easy to explain satisfactorily. All that is certain is, as I have already mentioned, that the white bug prefers dry, and the brown bug damp localities; and this is to be observed more in detail on any individual Estate: the brown bug will be found more plentiful in close ravines and amongst heavy rotting timber, than on open hillsides. The shifting from place to place depends probably, upon this predilection of the insect. The bug, of course, seeks out the softest and most sheltered parts of the tree: the young shoots, the underside of the leaves and the clusters of berries. The injury done by the white species seems worse than that of the brown, but not being so plentiful as the latter, it is of less general importance. The white bug is especially fond of congregating amongst the clusters of berries which drop off from the injury they receive: trees often lose their entire crop in this manner. The injury of the brown bug seems to have a more general effect by simply weakening the tree, but the crop does not drop off altogether, nor so suddenly. With white bug on the Estate the crop can hardly be estimated; with brown bug it can.

With regard to the nature of the injury a tree receives from the bug, it may be said that a tree thus attacked, suffers from *loss of blood* (*sap*) *and from partial starvation and suffocation.* In this manner: the bug, by means of its sucker, deprives the tree of its sap,

that is its blood and nourishment, after it has entered the organism; whilst the fungus, which never fails to attend upon the bug, with its rootlets and otherwise closes a vast number of the stomates through which the tree breathes and perspires, thus impeding its respiration. It is, moreover, probable that a tree covered with fungus, being as it were placed in the shade, the due decomposition of the carbonic acid of the atmosphere is prevented in such cases, and that the rootlets of the fungus act in a manner very similar to the sucker of the bug. It is not to be wondered then, that a tree covered all over with bug and fungus, should get exhausted. Bug exists on the Estates to an incalculable extent: none, I believe, are quite free from it. A thoroughly bugged tree will hardly produce any crop at all. Whole Estates are seen "black with bug," that is, with the fungus. Am I wrong in saying that if there was no bug in Ceylon it would, at a rough guess, produce Cwts. 50,000 Coffee more than it actually does? The value of this quantity on the spot being about £125,000, this sum would represent the aggregate of the annual loss by bug sustained by the Planters. But this is not all: the value of an Estate on which bug appears to be chronic, is of course, much less, yielding less crop, than that of a clean one.

I have been asked, how the bug came to an Estate? The eggs, which are a mere dust, are carried about by birds or insects to whom they adhere, or by the wind. If these are deposited in a favorable place they will hatch, and we have then the bug in the larva-state. The larvæ in course of time assume a more perfect form, the pupa-state, and eventually change into the imago or perfect insect. In the larva-state the male and female brown bug are not distinguishable, but in the pupa-state the male is very distinct, having all the characteristics of the perfect insect about it. In the white bug the male and female larvæ and pupæ are always distinct The perfect males either do not feed at all, or if they do, it is probably upon honey-dew, for having no sucker they cannot feed like the females. The number of eggs produced by a female brown bug is about 700. Those of the white bug are not so numerous. The species of bugs indigenous to cold climates, produce but one

generation of young annually; the propagation in our species being *continuous*, accounts in a great measure for their abundance here. The males are so delicate and minute, that they will hardly ever be observed on the trees, but they are easily reared in bottles.

The brown bug is dreadfully infested with parasites, especially the larvæ of minute Hymenoptera. The individuals attacked are generally full grown females, probably because they are the most juicy. The parasites are very numerous: not only have I found as many as six preying upon a single bug, but I have actually had difficulty in finding a sound old female for examination and (upon counting) repeatedly found that from fifty to seventy-five per cent were infested with parasites. If it be remembered that each of these would have produced some 700 young, it becomes at once clear that the parasites are of enormous benefit to the Planter. Indeed, it is a question whether Coffee planting could be carried on without them, for these parasites, the females of which by a benevolent design of nature greatly preponderate over the males are almost the only check upon the bug we have, no human ingenuity having hitherto devised a remedy that could be *profitably* employed either as a preventative or a cure. Numerous, indeed, are the suggestions which have been made on this point, but none have succeeded. The remedies resorted to at home by gardeners to destroy bug in conservatories or upon fruit trees, cannot be thought of here upon 90,000 acres of Coffee, each acre containing from 1,200 to 1,600 trees. Some six years ago it was suggested to introduce the large red tree-ant of the low country (Formica smaragdina Fab. *) on the Coffee Estates in the hope that it would destroy the bug. The suggester did not understand the relations actually existing between bugs and ants, besides the remedy was worse than the evil, these ants being so fierce and their bite so painful, that the Coolies would not go amongst the trees as long as they were there, Our bugged Coffee trees are visited by other species of ants commonly enough, but they do not drive away the bug: by means of tickling or caressing with the feelers, they induce it to emit a cer-

* The specific name applies to the female which is large and green; the male is smal and black; the red individuals usually found in the nests (and of which there are severa sizes) are the neuters.

tain saccharine fluid which it secretes, and this the ants eagerly eat, but they do not eat the bug itself. The latter act of ungratefulness may, and does, occasionally take place, but they do not seek the bug for this purpose. It is an old remark of Linnæus, that the Coccidæ and Aphides are the milch-cows of the ants Quite recently I found under the bark of a dead jungle-tree, a colony of ants and whitebug, the latter being to all appearances kept and fed by the former, and I can testify to the excellent condition the bugs were in. It may be said that the bugs might be otherwise injured by the visits of the ants, and die out, but there is not sufficient evidence for this assertion.

Rubbing off the bug by hand has been tried, but it can only be attempted upon young trees without crop. The quantity of bug destroyed by this simple means is certainly immense, but I am afraid that upon the whole the effect is but trifling.

The application of tar to the roots has been suggested, it being said that, taken up into the system of the tree, it throws off the bug. Although hitherto, no important results have been achieved by carrying it out, this idea strikes me as a *very valuable* one: *it is through the root of the tree the evil should be dealt with*, but a substitute for tar should be sought for, more powerful and more deadly to the bug, but at the same time equally harmless to the tree.

But generally, nothing at all is attempted to get rid of the bug, and under existing circumstances it is perhaps as well. High cultivation seems to have the effect of throwing it off also, and would be a very desirable cure if it could be carried out universally.—And suppose an Estate did get rid of the bug, would it not soon make its appearance again from a neighbouring plantation? As the bug eems to depend upon *locality*—as long as the physical aspect of that is not changed, what can be expected? unless it were by some cheap means destroyed simultaneously on all Estates. I should think that if pattenas, which are open, warm, airy localities, were cultivated (which they can be, as experiments on a large scale tried at Pusselawa, show) the brown bug, which is after all, the bug *par excellence*, would not find them so favorable to its existence as

the localities in which at present it thrives best; but again the white bug might find them very suitable places. Or, perhaps, if Estates as a rule were made smaller than they generally are, and if the reduction in acreage were counterbalanced by a higher system of cultivation, *universally* carried out,—bug would not be so plentiful as it is now.

I regret that I have nothing of more importance to say on this interesting subject.

It has been mentioned to me that the bug was subject to a desease—a white covering forming over and destroying it. This is simply mould. I do not believe that it ever attacks live individuals, but at very wet times and in very close places it may cover the old fixed females; the active part of the community would, one should think, move off. The black fungus also overruns old females or their empty shells.

Westwood, Introd. Vol. II 445-446, says that the ocelli are wanting and the month is completely obselete in the male Coccidæ, also that the male pupa is inactive and covered with a pellicle. From the descriptions given above, it will be seen that my observations differ from these statements: the male pupa of Lec. Coffeæ is as described by Westwood, but that of the Pseudoc. Adonidum is active. Ocelli and mouth are both very distinct in either species. I have not succeeded in catching a male brown bug in the act of emerging from its shell, altho' I much wished to ascertain whether it was done in the curious manner mentioned by Westwood.

With this I shall dismiss the Coffee bug, trusting that I have not dwelt too long upon it already.

5.—APHIS *Coffeæ*, (Coffee-louse.)

Both sexes: naked, shiny pitch-black with whitish rostrum, antennæ and legs and greenish abdomen. The rostrum reaches to beyond the base of the second pair of legs. The antennæ are seven-jointed, the first, second and sixth being short, the rest long, the 2 basal joints are black, the rest whitish, black towards apex. Legs with femora and tarsi nearly black, tibiæ nearly white, hindlegs with base of tibiæ slightly curved. Male four-winged, with black stigma in the upper ones. Female apterous. Abdomen in

both sexes two corniculate and with an anal tube. Size middling. Young individuals light colored.

The insect just described is found in larger or smaller communities upon the young shoots and on the underside of the leaves of the Coffee-tree. Its presence in large numbers produces honey-dew and Syncladium as in the case of the bug. The procreative powers of this family of insects (Aphidæ) is well-known, and unequalled in nature: from *one impregnation* nine fruitful generations of females have been produced in three months; in another instance eleven generations in seven months; in a third instance they continued to propagate for four years! (Westwood.) The eggs being hatched in the body of the mother-insect the young come forth alive. Such productiveness, however, does not appear to exist amongst the Aph. Coffeæ, at all events the communities are generally small and their injuries of no consequence. But a species which feeds upon the Orange, and Citron-tree is much more productive. From the anal tubercles a saccharine fluid is discharged of which ants are very fond, as in the instance of the Coccidæ.

The Aph. Coffeæ is subject to the attacks of various parasites:

Syrphus Nietneri.

„ *splendens.*

These are two large flies belonging to the family the members of which from their resemblance to bees and wasps, might be called "bee-flies." They rather resemble each other, are of dingy colors, black, abdomen variegated with whitish-yellow bands, the former is pubescent, the latter smooth; they are both $\frac{3}{8}$" long and $\frac{6}{8}$" across the expanded wings. Their larvæ devour the Aphides: these are soft, unsightly, eye-and footless worms, narrowed on one end, $\frac{1}{4}$" long when full grown. That of the Syrphus Nietneri is brown with a lighter dorsal mark, the segments are drawn out into scale-like knobs which form a ridge along the centre of the back. That of the Syrphus splendens is green with a whitish dorsal mark. They make immense havock amongst the Aphides, being so voracious that in tweny-four hours they increase double their volume. The pupa is pear-shaped, resting within the larva skin for eight days when the perfect insect comes forth.

Another enemy is :

Micromus Australis.

This is a pretty little insect allied to the tribe of the ant-lions. Feeding upon plant-lice, the larvæ have been called "Aphis lions," but from their shape they might more appropriately be styled "Aphis-Crocodiles." This larva is about 5-16ths" long, narrow, depressed, tapering towards both ends, lightly covered with white hair. It is of brownish color, sides, dorsal line and undersides white. It is very active and voracious, and has a pair of enormous sickle-shaped jaws, and long slender palpi and feelers. The former are distinctly three-jointed, the last joint being very long, and the whole palpi as long as the mandibles. Between head and throat there is a distinct neck. The larva encloses itself in a light Cocoon in which the pupa rests for two weeks, when the perfect insect makes its appearance. This latter is very delicate, brownish, with green eyes. The eggs of these insects are deposited upon leaves, each egg being furnished with a long, thin peduncle, thus resembling pins or certain fungi.

There are several minute Hymenoptera parasitic upon the Aphis Coffeæ, but I am unable to give their names.

6. STRACHIA *Geometrica.*

This is a bug, but of a different description from the brown and white bug, to which it bears but little resemblance It is oblong-oval, argulated, plump, 5-16ths" long by 3-16ths" wide, of yellowish color, marbled on the upperside, with grey and orange. It is allied to the so-called green or fætid bug.

Mr. Alexander Brown received this insect from Badulla and kindly forwarded it to me. It feeds upon the juice of the young berries, three per cent. or more of which were said to have been damaged from this cause. This is the only instance of Coffee suffering from this insect that has come under my notice. However, allied forms are found both here and in Europe, doing sometimes considerable damage to vegetables by destroying the buds. There is no fear of the insect ever becoming a *serious* nuisance on Coffee plantations.

I now come to the enemies of the Coffee tree belonging to the order of the Lepidoptera the larvæ of which, being entirely dependent upon the vegetable kingdom for their sustenance, do more or less injury to the horticulturists and agriculturists of every country. Fortunately, although I shall mention fifteen different kinds (a number that might easily be doubled) that feed upon the Coffee tree, there are but two or three which do any serious injury.

7. ALOA *lactinea.*

Caterpillar about 2" long, black, thickly covered with long brown hair, resembling the so-called "woolly bear" or caterpillar of the Arctia Caja at home. It is found during the dry weather, weaves an underground cocoon of earth and hair in which the chrysalis rests for two months, when the moth comes forth in July or August. This latter is 1" long and 2¼" across the expanded wings, of pure white, edged with red, and a few black marks on the wings; the back of the abdomen is yellow, variegated with black. It is also found upon the Eastern Islands; here it is by no means common.

8. ORGYIA *Ceylanica.*

Caterpillar 1½" long, brown, underside and head reddish, covered with yellowish hair, two long slender tufts of dark hair on either side of the head-like horns, and another behind like a tail, four short, stiff, white tufts upon the anterior part of the back, and two similar ones on either side. Not uncommon from October to December; spins a thin cocoon in which the chrysalis rests for two weeks. The female moth is an ugly, sluggish, maggot-like insect, with rudimental, whitish, scale-like wings, it is of dirty yellowish color, covered with fine black hair, rather thickly towards the extremity of the abdomen and the sides. It is ⅝" long. The male, on the contrary, is a lively little fellow, ¾" across the wings, brown, variegated with a little black and white, rather common during the beginning of the hot weather.

2. EUPROCTIS *Virguncula.*

Caterpillar hairy, black, variegated with red spots, ¾" long; from February to May spins a light cocoon in which the chrysalis rests for two weeks. Moth 1¾" across the wings, of pure white color, with black eyes, back of abdomen slashed with black, large yellow

tuft at the extremity. During the dry weather rather common upon the pattenas which alternate with the plantations.

10. Trichia *Exigua.*

Caterpillar from September to December, ½—¾" long, brown above, grey below, variegated with red and yellow lines and dots, hairy, each segment with two short tufts, behind head two fleshy earlike protuberances, a haunch upon forepart of back. It spins a light cocoon from which after two weeks the moth escapes. This is 1" across the wings, the upper ones of which are yellowish-grey with some yellow spots, the lower ones yellowish. It is not common. The caterpillar is also found upon orange and other trees.

11. Narosa *Conspersa.*

Caterpiller ⅜" long and ⅛" wide, oval, onisciform, transversely corrugated, (2) longitudinal dorsal costæ, margin flat, legs retractile, yellow. From August to November encloses itself (often in a single night) in an entire, strong, small, oval, cartilegious, white cocoon, with a circular brown spot on one end, which is commonly seen affixed to the Coffee leaves. The moth, which is rather common during the dry weather, is very pretty and often flies into rooms at night. It measures 1¼" across the wings, the upper ones of which are marked like a tiger, yellow and brown, the lower ones being yellow. The caterpillar keeps to the underside of the leaves and is not often seen.—It feeds at night.

12. Limacodes *Graciosa.*

Caterpillar from June to August, 1" long and 3"' broad, more so in front, less behind; back of opal-whitish color, sides greenish, the former with three broad, green, longitudinal stripes edged with darker green, four rows of glands covered with spines, four of which in front and two behind are tipped with brown, four lateral black spots near anus. Head brown, retractile. Ventral and anal feet abortive. Encloses itself under a thin tissue, in a strong, oval cocoon, or rather half-cocoon, the lower side being formed by the material to which it is affixed. The Chrysalis rests from the middle of August to the middle of October, it is short, plump, oval, and its skin slightly drawn out of the cocoon when the moth es-

capes. This latter is strikingly pretty, 1½" across the wings, of fine green color above, middle of thorax, shoulders, and broad margin behind rich chocolate brown, lower wings light grey-brown, rest of body dark brown. Westwood (Cab. Or. Ent.) is not correct in what he says about the male: this latter is like the female, but smaller, 1" across the wings, the antennæ are 2 pectinated from the base to the middle, whilst they are simple in the female. Both sexes have two green spots on the lower side of the thorax, which Westwood does not mention. Mr. Evatt, who kindly sent me the caterpillars of this insect, from Ambanpittia, writes that they are very active in destroying the leaves of the Coffee trees in that part of the country, that they disappear sometimes, but invariably return, and prefer fine young Coffee in sheltered places. I have also heard of them from Ambegamoa.

13. DREPANA.

I only mention this scarce insect on account of its curious caterpillar, which is occasionally met with upon Coffee. This is about 2" long, and as thick as a moderate goosequill, naked, occiput conical, a horn upon the anterior part of the back, anal feet wanting, body abruptly semi-truncated behind but drawn out into a tail of considerable length. It is of brownish-purple color, variegated with lighter patches on the sides in front, and grey rings on the tail. It resembles the caterpillar of the puss and kitten moth of England. The moth, of which I have no exact description (all my specimens having been lost in the Alma) is, if I remember rightly, about 1½" across, dark bluish-grey above and brownish below.

14. ZEUZERA *Coffeæ*.

This insect is of more importance to the Planter as it destroys many trees, young and old, the caterpillar eating out the heart; for this purpose it generally enters the tree 6" or 12" from the ground, ascending upwards. Fortunately it is not abundant. It resembles the caterpillar of the goat-moth of England, is 2" long, and as thick as a goosequill, nearly naked, of yellowish color, back red, head, thoracic and anal plates blackish; when full grown the colors are light and dirty. The sickly, drooping foliage, and a heap

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of globules of conglomerated wood dust at the foot of a tree, soon indicate that the caterpillar is carrying on its destructive work inside. The chrysalis rests three months, and its skin half protrudes from the hole when the moth escapes, which is about February. The moth measures 1¾" across the wings which are white, spotted with steel-blue, the upper ones with one large spot and numerous series of small ones, placed in rows between the nerves: the lower wings are less spotted. Thorax with four spots near margin. Abdomen variegated with blue. Legs blue, second pair with white femora, third pair with white femora and tibiæ.

15. AGROTIS *segetum*. (Black grub.)

The larva of this moth is the well-known and very destructive "black grub." It is 1" long and as thick as a goosequill, blackish with black head and lateral dots, nearly naked. It is most abundant from August to October. The chrysalis rests four weeks in the ground, and the moth comes forth in November and December. The latter is 1¾" across the wings, of clouded, dark grey-brown color above, with whitish posterior margin to upper wings; lower wings, abdomen and legs whitish-grey. The caterpillar is very common and injurious, whereas the moth is scarce. The former lives in the ground, but comes forth at night to feed. It attacks not only Coffee trees, but all sorts of vegetables and flowers, being consequently a great nuisance in gardens as well as in the field. I believe they eat everything that is artificially raised, despising grass and weeds. I have lost many valuable seedlings in my garden through them, and have seen as many as six of them engaged upon one Endive plant. On a neighbouring plantation they effectually put a stop to the cultivation of potatoes. It only attacks young Coffee trees, gnawing off the bark round the stem just above the ground. Should the trees be very small, they are bitten right off and the tips sometimes partially dragged under the ground, whence the grubs may easily be dislodged. The damage they thus do to young plantations is often very considerable. I lost, myself, in one season, in certain fields, as many as tweny-five per cent. of the young trees I had put out, through them. They generally appear only in

certain fields, not all over the Estate. A little lime put into the ground with the young plants is said to keep them off, which I can easily believe, but one would think that the ashes of the recently burned forest would be sufficient to do so.

The insect is by no means confined to Ceylon, its ravages being well-known in India, at the Cape of Good Hope, and in Europe: probably it occurs in many other countries. Its name, *A. segetum*, indicates the nature of its ravages in Europe—it injures the grain crops, but there, as here, almost any agricultural produce is welcome to it. I saw a notice in a recently published paper on its destruction of the Beet-root, which is very extensively cultivated on the Continent of Europe.

16. GALLERIOMORPHA *Lichenoides.*

This is a little moth, $\frac{5}{8}$" across the wings, of marbled dark grey-his brown color forward, lighter behind, which is occasionally found upon Coffee, where its larva feeds.

17. BOARMIA *Leucostigmaria.*

18. BOARMIA *Ceylanicaria.*

19. EUPITHECIA *Coffearia.*

These are three insects belonging to that family of moths the caterpillars of which from their way of moving (like leeches) are called loopers or geometricians. The caterpillars which are about $1\frac{1}{4}$" long and rather thinner than a goosequill, are evidently meant by nature to resemble, for their security, small twigs, and this they do to a very great degree. The color of that of the B. Ceylanicaria is, when young, dark, when older, light-grey, marked with dark patches and stripes along the sides, and there is a swelling about the neck and the tail. When at rest they stand straight on end (as leeches also sometimes do) and resemble twigs very closely. The moths, which are of delicate and slender make, are found sitting with expanded wings on trees or the walls of houses. They are found from September to December, but are anything but abundant. The Coffee tree is not the only one upon which the caterpillars feed.

The *B. leucostig maria* is rather a handsome moth, both pairs of wings being greyish-white, beautifully fringed, and marked with dark lines and red pencilling, below both are marked with

a large black stripe. It measures nearly 2" across the expanded wings; and the antennæ of the male are slightly two pectinated to within one-fourth of the tip.

The *B. Ceylanicaria* is smaller, yellowish-grey, marbled with brown. The *Eulpithecia* is still smaller and still darker.

20. TORTRIX *Coffearia.*

The larva is $\frac{3}{4}$" long, $1\frac{1}{2}$"' thick, nearly naked, greenish, head and thoracic plate brown. It is found nearly all the year round, not exclusively upon Coffee, but also upon a variety of garden plants, the leaves of which it draws together, residing inside. The moth is 1" across, shaped like a perpendicular section of a bell, light brown, clouded more or less with a darker tint of the same color It is not at all common.

21 GRACILARIA *Coffeifoliella.*

This is a moth of the most minute description, measuring but 1"' in length and 2"' across the expanded wings, it is of blackish color above with a few silvery spots, and greyish below. Its larva mines the Coffee leaves, and the ugly white lines and blotches so frequently and at all seasons seen upon the leaves are its work. It gets under the epidermis and eats out the inner parts of the leaf. The larva is $2\frac{1}{4}$"' long, yellow, flat, naked, undulated at the sides, tapering towards either extremity, eye and footless. The body consists of fourteen segments including the head, this latter is brown, pointed at the extremity, and one half retractile; it is furnished near the extremity with two antennal appendages, each with three hairs at the tip; the jaws are large and quite free at the extremity of the head, moring between two large reniform lips which gives the head a curious appearance The penultimate segment is the smallest of all and furnished with two spurs pointing outwards. The chrysalis is $1\frac{3}{4}$"' long, blackish in the middle and yellow at the extremities; the head finishes in 1 and the tail in 2 spines; antennæ and feet are free at the extremity. It rests for a short time under the epidermis of the leaf in a sort of cradle The insect is very common but of no importance to the Planter. Far different is it with an allied species, the *Elachista Coffeella G. M.*, the larva of which is the greatest enemy of the Cof-

fee tree in the West Indies. This latter is of silvery-white color.

22. ANTHOMYZA? *Coffeæ.**

This is an inconspicuous grey fly, measuring hardly 1½‴ across the wings, the larva of which mines the Coffee leaves in the same manner as that of the preceding species, but much less extensively. It is found more particularly during the dry weather, but is not numerous. The larva undgergoes its transformation in a minute, flat, oval cocoon (resembling a seed) under the epidermis of the leaf.

23. PHYMATEA *punctata.*

This is the large, well-known, beautiful locust with the scarlet abdomen, yellow and bronze above, which seems to attack all agricultural produce that comes in its way. It does not habitually attack the Coffee tree, but does so occasionally, and I speak from experience when I state that its ravages are very annoying. A swarm of them settled upon a field of one year old Coffee and gnawed the bark off the stems. The consequence was that the growth of the tree was checked in the upper part, and that a multitude of unsightly shoots were thrown out by the lower; eventually the top broke off, or was cut off, and the tree remained disfigured for the rest of its existence. There were at least fifteen per cent. of the trees thus injured. I remember seeing a Cocoanut plantation at Negombo infested with these locusts, the enormous leaves of the trees bending under their weight and presenting mere skeletons—everything but the ribs having been devoured. A great many of the locusts had dropped off upon the Illook-grass (*Sachch. Kœnigii. Retz.*) which grew beneath, but they would not touch this, in fact I have never seen them eat any but cultivated plants or trees. At Tangalle I have known them to destroy tobacco plantations; and, a couple of years ago, I was addressed by the Government Agent, Kandy, with reference to the destructions the grain crops of the natives in Matelle were then suffering from

* Not *A. Coffeifolia* as printed in Motch Et. Ent. Nor is the larva parasitic upon that of the *Gracilaria*, as M. de Motch suggests, never being found in the same burrows, but generally upon separate leaves.—Perhaps belonging to *Agromyza*.

these locusts. Fortunately this seems the only species of locust that does any real injury in Ceylon, and this injury is in importance not to be compared with that done by other species in other countries.—See Kirby and Spence's Introd. to Ent. for details on this subject. The larvæ and pupæ are equally destructive as the perfect insects.

24. ANCYLONYCHA *Spec ?* (*White grub.*)

Under the name of "white grub" the larvæ of various Melolonthidæ do much harm to Coffee plantations, young and old, by eating the roots of the trees. These insects are the Cockchafers of this country, and their injuries are of the same nature as those of their representatives at home. Mr. J. L. Gordon, of Rambodde, kindly sent me a bottle full of these grubs, for examination. They were 1¼ inch long and ¼ inch thick, whitish, thinly covered with red hair, mandibles strong, legs four jointed, second and third joint soldered together, antennæ five jointed. As the larvæ of the cockchafer family remain for years in that imperfect state, it is difficult to rear them. I took the larvæ sent me for that of a species of Ancylonycha* which, in its perfect state, is very common about Coffee estates during the dry weather, but there are undoubtedly other species the larvæ of which feed with that of the Ancylonycha. Mr. Gordon mentioned that he sometimes found larvæ three times as big as those he sent me. These belonged in all probability to the *Leucopholis pinguis*, the large cockchafer, which flies about the pattenas on fine evenings during the dry weather. But I feel certain that cases in which it feeds upon Coffee roots are exceptional, as I have very commonly seen it emerge from the ground on the pattenas; from which circumstance I conclude that it generally feeds upon the roots of the pattena-grasses (*Andropogon, Anthistiria, etc.*) There are many representatives, large and small, of the cockchafer family in this country, but they appear to do no damage in the perfect state.

With regard to the ravages of the white grub, Mr. Gordon writes: "They are in my experience by far the greatest enemy of the

* Probably A. Reynaudii Blanch.; perhaps A. mucida. Schœn.

Coffee tree we have to contend against, as I never knew a single tree to recover after their attack. The damage done here, during the last two years, has been very great—between eight and ten thousand trees of fine old Coffee have been destroyed." Fortunately such extensive injuries are exceptional cases. Mr. Gordon used to dig up the soil at the foot of the trees, and take out such grubs as he could find.

25. Arhines ? *destructor.*

This is a beautiful green weevil: 2½‴ long and 1‴ broad, oval, narrowed in front, covered all over with closely set but isolated gold-green scales, winged. The head is rather short and blunt; antennæ apical, elbowed at the middle, the part beyond the middle being composed of eleven joints, forming a club towards the end, the third joint from the tip being the thickest; they are brown, hairy beyond the middle; the thorax is plump, subconical; the anterior legs are the longest, the second pair the shortest, the tibiæ and tarsi of all are hairy, the tarsi with hairy brushes underneath, especially thick at the third joint which is deeply 2-lobed, the tibiæ of the second pair are long, serrated inside, curved and 2-hooked at the apex. The insect varies considerably in size and color.

This pretty beetle is common during the dry weather, but I have never found it do any injury to the Coffee. Mr. James Rose of Maturatte, who first directed my attention to it, writes to me: "The mischief they do to the Coffee is really frightful, and if they were as plentiful as the bug, they would be our worst enemies. Five or six acres were completely covered with them, and they consumed almost every leaf. Year after year they appeared upon the same place. This year they appeared upon a neighbouring Estate in great force, and ran over at least forty acres. The same thing occurred on three other Estates." Mr. Rose conveys a pretty picture to the mind of the entomologist by stating, that in May, when these insects disappear, the logs and rocks may be seen strewed with their bright green elytra.

The family of the weevils is one of the most extensive amongst the beetles, and many of its members both here and in Europe do

much injury to agricultural produce. I have seen nearly the whole Sweet potato (*Batatas edulis*) crop of the Negombo district destroyed by one of them, the *Cylas turcipennis*. The common rice-weevil, *Sitophilus Oryzæ*, is another instance, and one of the Cocoanut destroyers of the low country belongs also to this family, the *Sphænophorus planipennis*.

26. Acarus *Coffeæ*.

This is a very minute mite, hardly perceptible to the naked eye, which feeds upon the Coffee leaves nearly all the year round, but more commonly from November to April; giving them a brownish, sun-burnt appearance. The damage it does is not great in the aggregate, but individual trees certainly suffer from it. It is closely allied to the "red-spider" of the hot houses in Europe: oval, naked, light red, abdomen darker, four rows of hair along the back, legs hairy. It feeds on the upperside of the leaves where, amongst the live insects, empty skins and minute red globules are found in plenty. These globules are fixed by a style to the leaf, and are the young in the first stage of existence: the style is the mouth, but the rest of the body is a perfect globule without any appendages whatever. These latter, however, gradually break forth, and when the animalcule is furnished with all it requires, it lets go its hold.

27. Golunda *Ellioti*. (Coffee Rat.)

This well-known animal does not habitually reside on Coffee Estates, but comes, apparently, when its food fails, from the jungle to the neighbouring Estates to supply its wants there. Hence Estates with much surrounding jungle are more liable to be infested than others, in the same way as the fields adjoining the jungle suffer more than the more remote ones.

There is a plant which forms a common underwood from six to twelve feet high in the upper jungle—the "Nilloo" of the natives (*div. spec. of Strobilanthus*,)— of which it is said that it blossoms every seven years and then dies, whereby the rats are deprived of their accustomed food and induced or compelled to issue forth on to the Estates. This is a popular story, but it is not clear to me, and I have no confidence in it. That the Nilloo

blossoms and dies off every seven years, and that the rats feed upon some part of it, I will not dispute. But the Nilloo is not all of the same age, and consequently some will die every year. Besides, the story of the rats coming every seven years is not at all borne out by my experience: we had them here in 1858 and in 1860, and again in 1861. However, when they do come, they are sometimes in very great numbers, and their devastations, are very serious. With their long sharp incisors they bite off the smaller and younger branches of the trees, beautifully, regularly and smooth, and generally 1" or so from the stem, so as to allow them to rest upon the stump whilst they are gnawing it through. Should the plants be quite young, just taken from the nursery, they bite them right off a few inches from the ground. Their object in doing this is, no doubt, first to get, like other Rodentia, at the bark, which they do not appear to devour entirely, but simply to masticate for the sake of the juice, but probably they act in this respect in accordance with the state of their appetite, and secondly to get the leaves for their nests. These latter are commonly found in hollow trees, whither they also drag the bitten-off branches. They seldom appear to eat the berries. They are destroyed either by poison or by traps, in which latter enormous numbers are said to have been caught. There is hardly an Estate that does not now and then receive a visit from them.

A small Squirrel (probably the *Sciurus Layardi*. Blyth.) is commonly found about Coffee Estates: this does what the rat apparently does not—eat the berries, which, being indigestible with the exception of the outside pulp, are afterwards dropped and found upon logs and on the ground, in the shape of parchment Coffee. Jackals and monkeys occasionally do the same, and a deer will now and then come from the forest and nibble the tops of the young trees—but these are not serious injuries. By far more so are those arising from buffalo trespass.

This concludes my observations on the Enemies of the Coffee Tree. However, I must add a few words on the Insects commonly found on Coffee Estates, without being injurious, and the cause of their presence there.

Most conspicuous amongst these are the black stag-beetle (2 spec. Lucanus), the bright green carpenter-beetle (5 spec. Campsosternus), and the white and black carpenter-beetle (2 spec. Alaus.) These insects live, during the imperfect stages of their existence, in the rotting logs which lie about amongst the Coffee: the large, white, fleshy grubs with brown heads, are the larvæ of the Stag-beetle; the long, cylindrical, sluggish, brown worm, is that of the Campsosternus; and the larva of the Alaus is black, rather depressed, active, and pugnacious. On attaining the perfect state these insects come forth, and, of course, are seen upon the Coffee, where the Stag-beetle will now and then attack a cluster of berries. The Campsosterni feed upon honey-dew and Acari, and occasionally devour perhaps a bug. From this reason they are exclusively found upon Coffee trees, whereas the Lucani and Alaus fly about and are met with elsewhere. The smaller kinds of white grubs found in the rotting logs are the larvæ of the flat, black beetles found with them (3 or 4 spec. Passalus): these larvæ have only two pairs of well-developed legs, are harmless, and must not be confounded with the "white grub," the larvæ of cockchafers. About December, a grey weevil (*Astycus spec.*) is found upon the trees, and the blossoms which come forth some months later, are frequented by various insects allied to the English Rose-beetle (*Clinteria, Tæniodera, Popilia, Singhala*), but none of these appear to do much harm.

A bugged tree presents, on a fine sunny day, generally a very animated, and, to the Entomologist, highly interesting picture—a perfect microcosm, a small world of its own.

Besides some of the insects just alluded to, and perhaps some gaudily colored butterfly, numerous Hymenoptera (especially Formicidæ, Sphegidæ and Ichneumonidæ), several Phryganidæ and Diptera resort to it, and a bright green Mantis pounces constantly out from behind the leaves upon the unwary flies. I believe that twenty-five different species of insects might easily be gathered off a single Coffee tree on such an occasion. None of these insects do any injury to the tree, nor to the bug either, most of them resorting to the tree for the sake of the honey-dew, and some in order to prey upon the smaller insects which are at-

tracted by this sweet substance. Amongst the Phryganidæ (Caddice flies) is very common the Chimarrha auriceps Hag., which is red with black wings, feelers and eyes. I mention this insect particularly, because Westwood, Introd. Vol. II. 69, says that the caddice flies in their perfect state take no nourishment. This, however, is not so in the species which frequent the Coffee tree.

The Mantis of the Coffee tree (*M. tricolor.* N.) is green, lower wings reddish, with large blackish spot at posterior margin. The female is 1" long, expanse of wings 1½"; the male considerably smaller. The young larvæ are black. The eggs are deposited upon Coffee leaves in cocoon-like masses of ⅝" in length, not including a long point to which the mass is drawn out on either end, and which would make it upwards of 1" long. These nests are very delicate, cake-like structures, much less coarse and substantial than those of the larger species. Amongst the flies, there is, about December, a fine large Tephritis with green eyes and variegated wings. I have not observed its larva to reside in any part of the Coffee tree.

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